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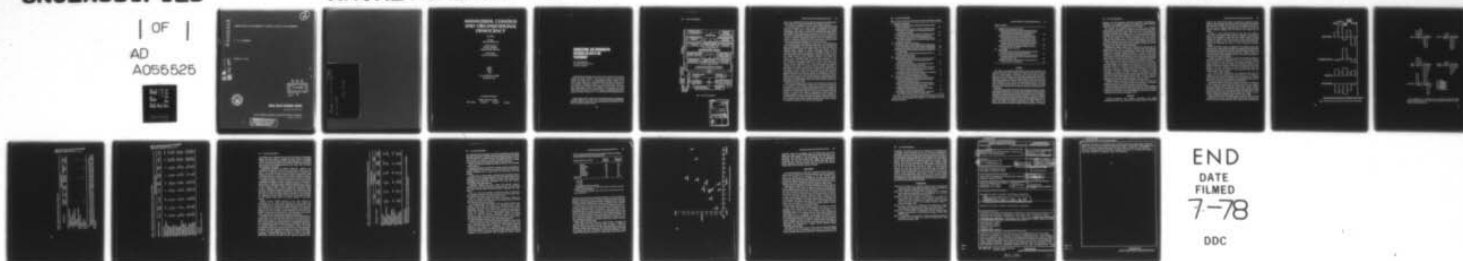
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ORGANIZATIONAL AND ENVIRONMENTAL INFLUENCES ON HEALTH AND PERFORMANCE

E. K. E. GUNDERSON

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# MANAGERIAL CONTROL AND ORGANIZATIONAL DEMOCRACY

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# **ORGANIZATIONAL AND ENVIRONMENTAL INFLUENCES ON HEALTH AND PERFORMANCE<sup>1</sup>**

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Organizational coordination and control must be viewed in the context of existing technology, prevailing social values, and degree of environmental hazard. The modern navy is a technologically advanced segment of the national society and also is a self-contained institution with a unique history and traditions. Meaningful analysis of naval organizations requires an appreciation of the sociocultural and political context in which the modern naval establishment operates. The problems of coordination and control aboard navy ships offer a fertile field for research on managerial practices and group performance. Because the ship is a closed and isolated ecological system

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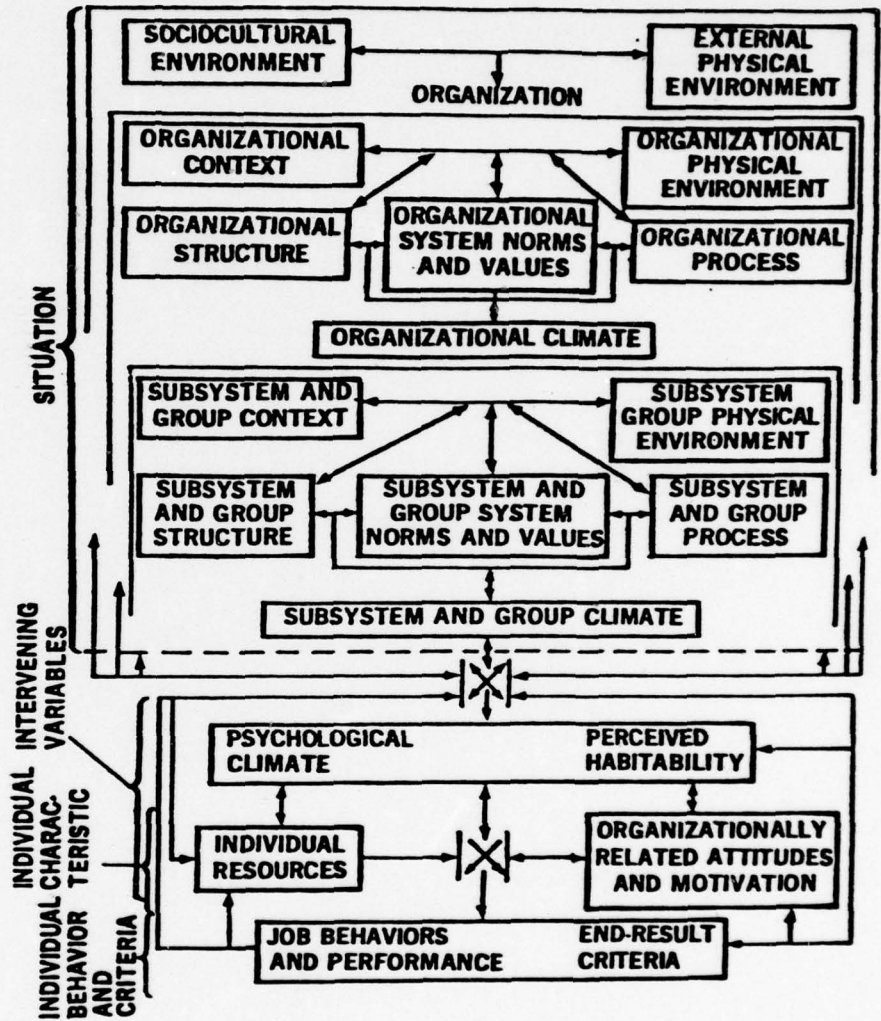


Fig. 1. Social system model

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while at sea, organizational and environmental constraints and leader behaviors have an impact on all aspects of the sailor's day-to-day life experience.

The study to be described is part of a larger research program concerned with the development of a social system, or integrating, model which encompasses a wide range of environmental, organizational, and individual characteristics and provides a framework for analyzing relationships between the individual and his organizational environment and also for evaluating the effectiveness of individuals, organizational subsystems, and the organization as a whole in achieving organizational objectives. The term integrating model refers to an attempt to represent both the characteristics of persons and the properties of organizational settings as well as their interactions.

The model represents organizations at several levels: external environment, total organization (ship), major subsystems (departments and divisions), work groups, and individuals. In a recent paper James, Jones, Bruni, Hornick, and Sells (1974) have explicated the model in detail and reported a series of empirical analyses designed to examine relationships among its major components. Some of these relationships are exemplified in Figure 1, where each organizational level (total organization, subsystem, work group) has its own context, structure, process, physical environment, and climate components and is embedded within the next larger subsystem or level. Interconnecting arrows represent interrelated events and interactions of the type proposed by integrating models. In the present study, relationships between selected components of the social systems model and subsystem performance and safety are examined, and the possible relationships of coordination and control processes to these components are explored. Aboard Navy ships, it will be shown that the division is the most important organizational level for assessing the influences of organizational climate and physical environment and examining problems of coordination and control. Primary attention is given to the variable domains of organizational climate and physical environment because these domains have important influences on performance and health (safety) (James, Jones, Bruni, Hornick, & Sells, 1974; Pugh, Erickson, & Jones, 1976).

Problems of coordination and control are central concerns in the operation of any organization. Coordination is defined here as the division of labor and the structuring of work activities. Control system refers to procedures for monitoring, evaluating, and changing job behaviors to conform to management objectives. Thus, coordination and control are viewed as management initiated processes to regulate work behavior. Organizational control systems are primarily designed to achieve and maintain satisfactory levels of performance; coordination and control efforts also may have important secondary effects on worker satisfaction and retention. Finally, coordination and control processes have significant implications for workers' health and safety.

Table 1. Climate Components and Defining Variables with Highest Loadings<sup>a</sup>

<b>I. <i>Conflict and ambiguity</i></b>		
Subsystem conflict: degree to which subsystem goals, policies, and actions conflict.		.66
Ambiguity of structure: degree to which role definition, lines of authority, responsibility, and communication channels are undefined or unclear.		.66
Interdepartmental cooperation: degree of cooperative action, communication, and mutual help among departments.		-.57
Communication-down: degree to which information is communicated to subordinates on matters affecting their work, status, and well-being.		-.55
<b>II. <i>Job challenge, importance and variety</i></b>		
Job challenge: degree to which individuals receive opportunities to make full use of their abilities, skills, and knowledge.		.75
Job importance: degree of importance of job to organization.		.68
Job variety: range of types of tasks, equipment, and behaviors involved in jobs.		.67
Job isolation: degree to which job restricts opportunities to interact with other persons.		-.54
<b>III. <i>Leader facilitation and support</i></b>		
Work facilitation: degree to which leaders provide resources, guidance, problem solutions, and aid subordinates in achieving planned goals.		.80
Interaction facilitation: degree to which leaders encourage development of close, cohesive work groups.		.77
Leader support: degree to which leaders are aware of and are responsive to needs of subordinates and show consideration for their feelings of personal worth.		.72
Goal emphasis: degree to which leaders stimulate subordinates' involvement in meeting organizational goals.		.72
<b>IV. <i>Workgroup cooperation, friendliness and warmth</i></b>		
Cooperation: existence of an atmosphere of cooperation to carry out difficult tasks; evidence of mutuality of goals and sharing of reward for success.		.75
Reputation for effectiveness: degree to which work group enjoys a record of effective performance and is expected to perform well by peers as well as supervisors.		.72
Friendliness and warmth: degree to which warm, friendly relations, trust and mutual liking prevail.		.64
Esprit: degree to which members show pride in their group, their fellow members, and their record as a group.		.59

<sup>a</sup>The four composites with highest loadings are described for each component; only three composites had loadings of .40 or greater for the Job Standards component.

Table 1. (cont'd)

<b>V. Professional and organizational esprit</b>		
Professional esprit: degree to which individuals believe that their profession has a good image to outsiders and provides opportunities for growth and advancement.		.79
Organizational esprit: degree to which individuals believe that the organization performs an important function and offers them opportunities for growth and reward.		.66
Openness of expression: degree to which organizational atmosphere fosters expression of ideas, dissent, criticism, opinions, suggestions, and other information upward.		.64
Confidence and trust—up: degree of confidence and trust of members in their superiors.		.61
<b>VI. Job standards</b>		
Job standards: degree to which exacting standards of quality and accuracy are required in job performance.		.54
Job pressure: adequacy of time, information, and resources to complete assignments and degree of threat implied for substandard performance.		.40
Confidence and trust—down: degree of confidence and trust of superiors in their subordinates.		-.40

## METHOD

The study to be described sampled 20 U.S. Navy ships operating in the Atlantic and Pacific Oceans during the latter half of 1973. Eighteen of the 20 ships were destroyer-types: 4 destroyers or DDs (crew size about 225); 6 destroyer escorts or DEs (crew size about 250); 5 guided missile destroyers or DDGs (crew size about 280); and 3 missile frigates or DLGs (crew size about 360). The remaining two ships were attack aircraft carriers which represented major differences in size, mission, and organizational structure. The social system of primary interest was the crew of a small destroyer-type naval ship (crew size 225 to 360 men) and its principal subsystems, namely, departments and divisions.

Each destroyer-type ship had at least four departments: Weapons, Supply, Engineering, and Operations. In addition, frigates (DLGs) had Communications Departments and approximately one-third of the ships had separate Navigation Departments. The four major departments generally were made up of divisions as follows: (a) Weapons Department—Deck, Ordnance (Guns), Fire Control, and Anti-Submarine Warfare divisions for all ships and Missile divisions for the DDGs and DLGs; (b) Supply Department—one Supply division; (c) Engineering Department—Boilers, Machinery, Repair, Electrical, and Auxiliary

divisions; and (d) Operations Department—Navigation, Communications, Electronics, and Intelligence divisions. The numbers of possible subsystems available for study were 105 departments and 281 divisions.

The primary test instrument used in the study was a 400-item questionnaire, the Habitability and Shipboard Climate Questionnaire, which contained biographical and service history data, 145 items pertaining to organizational and job characteristics, and a set of environmental dimensions describing work and living conditions. Crew members rated their working areas, messing (eating) areas, berthing (sleeping) areas, heads (sanitary facilities), and the entire ship on 11 environmental dimensions: temperature, ventilation, cleanliness, odor, size, number of people, lighting, color, privacy, noise, and safety. This questionnaire was administered to ships' crews near the beginning of 7- to 8-month overseas deployments.

Organizational climate measures were constructed by grouping the 145 questionnaire items into 35 composites reflecting salient job, leadership, division, work group, and total organization variables, and subjecting these composites to principal components analysis in a sample of 4,315 Navy enlisted men. The analysis yielded six higher order climate components, which are described in Table 1. The derivation of these components is described in detail in James et al. (1974) and, in addition, the relationships among division context, structure, climate, and other organizational variables are presented.

Eight dimensions of division performance, derived from 24 descriptive statements designed to be applicable to all divisions, were evaluated by each department head for the divisions in his department. The 24 items were presented to raters in a "mixed-standard" format (Arvey & Hoyle, 1974); these items defined the following dimensions: (a) quality of work; (b) completion of planned maintenance schedule; (c) readiness to fulfill commitments; (d) performance under pressure; (e) efficiency; (f) cooperation with other divisions; (g) leadership; and (h) safety. The safety rating was dropped from the present analysis because it did not pertain directly to performance and did not correlate substantially with other criteria.

Additional division performance criteria were ratings by division heads concerning: (a) the use of drugs and alcohol ("nonexistent" to "frequent"), and (b) the frequency of requests for transfer out of the division.

Illness and accident data were collected on all ships by recording individual dispensary visits throughout the overseas deployments. Records of disciplinary offenses were obtained for seven of the Pacific ships and provided a basis for an analysis of the correlates of disciplinary rates.

## RESULTS

*Physical Environment.* Crew members' perceptions of the physical characteristics of their work environments are shown in Figures 2 and 3. Mean

ratings on five environmental scales were derived by departments and by divisions within department. The highly correlated temperature and ventilation dimensions were combined into one scale, as were cleanliness and odor and size and number of people (crowding). Noise and safety were treated as separate dimensions; lighting, color, and privacy were omitted from this analysis.

In Figure 2, mean standardized values for each scale were plotted to provide work area profiles for four departments—Navigation, Communications, Weapons, and Engineering. Values above the mid-line represent favorable environmental conditions, and values below the mid-line represent unfavorable conditions. In Figure 3, mean values for divisions within two departments—Weapons and Engineering—are shown for each environmental dimension separately.

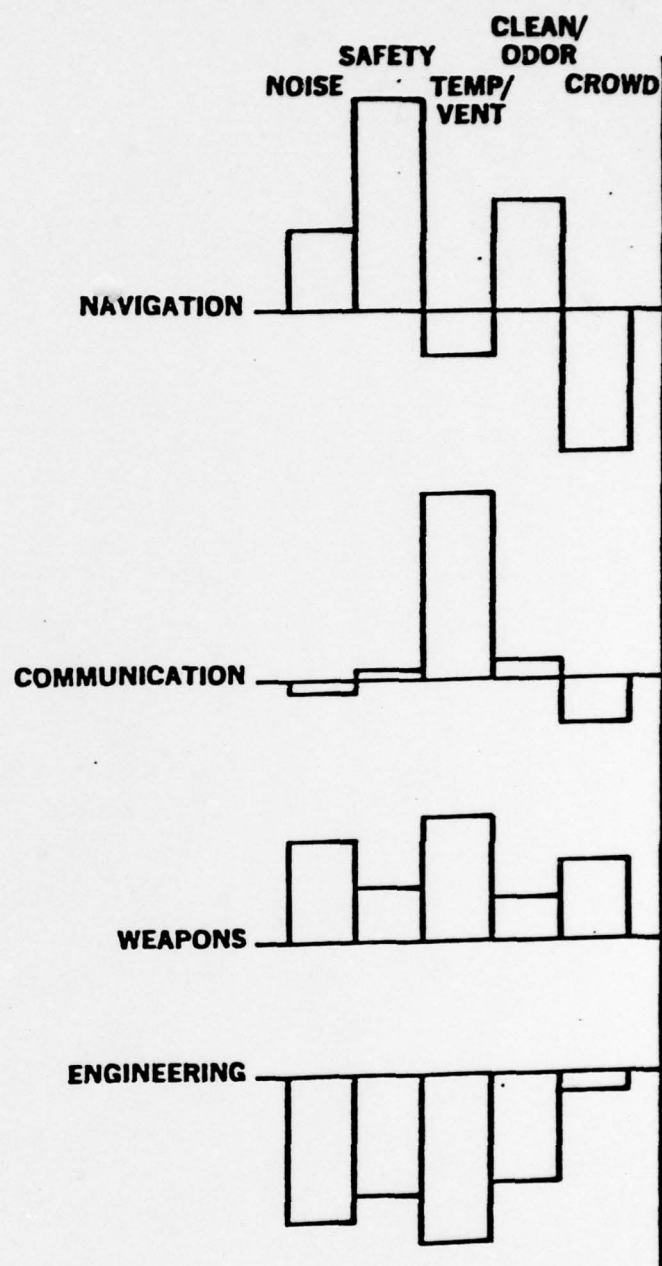
When environmental ratings were aggregated at the department level, large differences in perceived working conditions were apparent (Fig. 2). Navigation, Communications, and Weapons personnel, although differing somewhat on all environmental dimensions, generally reported their working conditions as relatively favorable, while Engineering Department personnel experienced very unfavorable environmental conditions.

In Figure 3, working conditions were compared among divisions within two departments—Weapons and Engineering—and it can be seen that divisions within departments varied markedly in environmental conditions. The most striking example was that the Boilers and Machinery divisions of the Engineering Department differed considerably from the Repair and Electrical divisions of the same department on almost all dimensions. Boilers and Machinery work areas were reported to be extremely hot, dirty, noisy, and unsafe compared to other divisions.

These results clearly demonstrated two important points that have relevance not only for performance and safety but also for problems of coordination and control: (a) Physical work environments vary markedly among major ship subsystems (departments and divisions), and (b) much of this variance can only be accounted for at the division level.

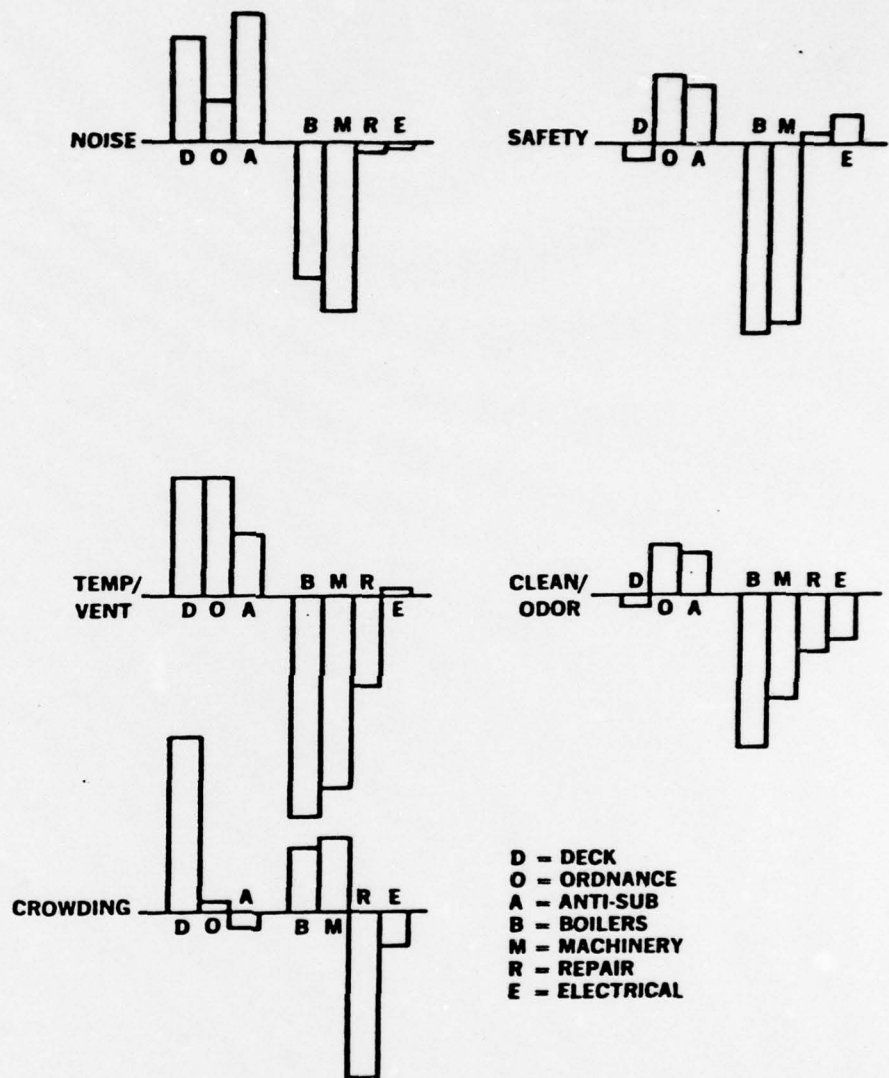
*Organizational Climate.* Not only do divisions aboard ship vary considerably in work environment characteristics, but division types also vary widely in structure, staffing, equipment, technology, and functions or tasks. A multiple discriminant analysis was conducted to classify average profiles of climate scores for 223 divisions into a meaningful typology of division climate. Twelve functional types were enumerated, and this number was reduced to seven by means of a hierarchical grouping procedure (Jones & James, 1976).

Climate profiles for the seven division types are shown in Table 2 in terms of deviations of more than one-half standard deviation from the grand mean for each of the six climate components. Thus, salient climate characteristics of



\*HIGH SCORES REPRESENT FAVORABLE HABITABILITY

Fig. 2. Differences in perceived work environments by department.



**Fig. 3.** Differences in perceived work environments by division within Weapons (deck, ordnance, anti-submarine) and Engineering (boilers, machinery, repair, electrical) departments.

Table 2. Differences in Climate Profiles by Division Type<sup>a</sup>

Division type	Climate components				
	Conflict, ambiguity	Job challenge	Leader support	Workgroup cooperation	Professional esprit
I. Navigation, Anti-Submarine Warfare, Guns				+	
II. Missiles, Fire Control, Nuclear, Auxiliary, Repair, Electrical	+				- +
III. Communications, Intelligence					
IV. BOLLERS, Machinery				-	
V. Deck		- -	-	-	- +
VI. Electronics	++			+	
VII. Supply					

<sup>a</sup>++ indicates that the division type mean was one standard deviation or more above the mean for all divisions.  
+ indicates that the division type mean was one-half of a standard deviation above the overall mean; - indicates one-half standard deviation below the overall mean; and - - indicates one standard deviation or more below the overall mean.

Table 3. Correlations between Organizational Variables and Division Performance<sup>a</sup>

Organizational variables	Division performance criteria							
	Quality	Maintenance	Readiness	Pressure	Efficiency	Cooperation	Leadership	Transfer
Division context:								
Condition of equipment	19*	24**	29**	14	16*	11	15	-17*
Division structure:								
Size of division	-16*	-11	-08	01	-11	-10	-13	28**
Specialization	-14	-19*	-12	-22**	-22**	-02	-07	-06
Number of levels	-06	-05	-03	01	-05	08	-06	16**
Span of control	01	07	14	02	06	03	00	-33**
Division climate:								
Job challenge	-01	12	06	03	07	-06	01	-29**
Leader support	05	14	02	15	18*	13	22**	-18*
Workgroup cooperation	33**	37**	33**	22**	24**	24**	24**	-44**
Professional esprit	05	01	05	00	05	25*	-02	05
Personnel resources:								
Time in Navy	06	10	11	03	07	11	-01	-36**
Advanced training	32**	30**	29**	28**	23**	21**	24**	-33**
Years of education	19*	13	18*	21**	21**	15	12	-44**
Intellectual aptitude	20**	26**	20**	17*	19*	08	20*	-43**
Quality of personnel	29**	26**	29**	35**	32**	29**	43**	-23**
								-27**

\* $p = .05$ .

\*\* $p = .01$ .

<sup>a</sup>Decimals are omitted;  $n = 160$ .

each division type are indicated. For example, the Navigation, Anti-Submarine Warfare, and Guns cluster of divisions are above average in cooperative, friendly, and warm work group relations. Deck divisions, on the other hand, report a very low level of work group cooperation, friendliness, and warmth, a very low level of job challenge, importance, and variety, and a low level of leader facilitation and support.

*Organizational Correlates of Division Performance.* Analysis of the organizational variables that predict division performance might yield useful clues as to coordination and control practices that are consistent with effective performance. Correlations between selected organizational variables and division performance ratings are shown in Table 3. Variables considered to have possible relevance for coordination and control activities were included.

Correlations generally were low to moderate, but the overall pattern of relationships was suggestive. Quality of personnel resources, as indicated by average years of education, average intellectual aptitude score, amount of advanced training, and division officers' ratings of personnel quality, appeared to have a powerful effect on division performance. Among the climate dimensions, Workgroup Cooperation, Friendliness, and Warmth had special importance for predicting division effectiveness in that all correlations with the criterion measures were highly significant. Condition of work equipment was significantly correlated with six of the criteria, but generally this variable was less important than quality of personnel resources or work group relations.

Division structure variables appeared to have minor influence on performance, but the trends were interesting from the perspective that increasing division size and complexity might make coordination and control more difficult. Size of division, specialization (diversity of job types), and number of job levels all tended to correlate negatively with performance, although few of the correlations achieved significance for all divisions taken together. A small span of control, that is, close supervision, was associated with low frequency of transfer requests and drug and alcohol use.

*Correlations between Organizational Variables and Division Effectiveness by Division Type.* It is clear that large differences exist among divisions in physical characteristics of work environments and in organizational climate. This raises the question of whether patterns of organizational predictor-criterion relationships are similar in different types of divisions or whether there are important differences in the organizational variables that predict performance by division type. If the latter were the case, it would suggest that coordination and control processes also might vary in type and effectiveness. In order to test this proposition, two clusters of divisions were formed, representing a relatively high technical level and a low to intermediate technical level. The clusters included: (a) *High Technical*—Navigation, Guns,

Table 4. Correlations between Organizational Variables and Division Effectiveness by Division Type<sup>a</sup>

Organizational variables	Effectiveness Criteria							
	Quality				Maintenance			
	High Technical <sup>b</sup>	Low Technical <sup>c</sup>	High Technical	Low Technical	High Technical	Low Technical	High Technical	Low Technical
Division structure:								
Division size	-03	-27*	-17	-22	44**	31*		
Specialization (Job diversity)	-45**	13	-35*	12	-17	15		
Span of control	-26	27*	04	28*	-28	-38**		
Division climate:								
Workgroup cooperation, friendliness and warmth	38**	38**	40**	36**	-23	-31**		
Personnel resources:								
Time in Navy	-17	31*	08	08	-19	-44*		
Advanced training	49**	27*	51**	17	-15	-23		
Quality of personnel	37*	11	53**	05	-28	-23		

<sup>a</sup>Decimals are omitted.

<sup>b</sup>High Technical divisions (n = 44) - Guns, Fire Control, Missiles, Anti-Submarine Warfare, and Navigation.

<sup>c</sup>Low Technical divisions (n = 55) - Deck, Supply, Boilers, and Machinery.

and Anti-Submarine Warfare (Type I in Table 2) and Missiles and Fire Control (Type II); and (b) *Low Technical*—Boilers and Machinery (Type IV in Table 2), Deck (Type V), and Supply (Type VII). Combining divisions from the various types was necessary to provide sufficiently large  $n$ 's to conduct correlational analyses and comparisons. Results are shown in Table 4.

Division size correlated positively with drug and alcohol use for both High and Low divisions.

Specialization (diversity of jobs) had a negative impact on performance in the High divisions, but no effect in the Low divisions. This result suggests that division complexity had an adverse effect on performance in the High divisions.

A smaller span of control (closer supervision) had a beneficial effect on performance for Low Technical divisions but not for High divisions. This is consistent with the proposition that less technical, more routinized, more standardized jobs need more coordination and control than technical, nonroutinized, nonstandardized jobs.

Cooperative, friendly work group climate was positively related to effectiveness for both division types. It seems plausible that warm and friendly peer group relations would universally facilitate coordination and control efforts.

Time in the Navy was positively correlated with quality of performance and negatively correlated with drug and alcohol use for Low divisions only. This variable had no effect on the maintenance criterion.

Both the advanced training and quality of personnel variables had substantial correlations with performance for the High divisions; correlations were much lower for the Low divisions.

Thus, in High divisions, division effectiveness was primarily dependent upon superior technical skills and abilities, low specialization (Low division complexity), and work group cooperativeness. In Low divisions, division effectiveness depended to some extent upon division size, small span of control, Navy experience, and work group cooperativeness. These different patterns of correlation between organizational variables and division effectiveness criteria for diverse types of divisions suggest that coordination and control problems and practices also may vary in such a manner as to be consistent with division structure, climate, and personnel resources.

*Manpower Utilization and Division Performance and Safety.* A recent study of the relationships of division manning levels of division performance and injury rates (Dean, Harvey, Pugh, & Gunderson, 1976) provides a more direct example of the influence of coordination and control practices on organizational effectiveness. The Manpower Utilization scale was designed to measure the efficiency of personnel utilization within divisions. The scale was composed of four questionnaire items reflecting: '(a) division members'

**Table 5. Correlations of Manning Level and Perceived Manpower Utilization with Division Performance and Injury Rate<sup>a</sup>**

Division performance criteria:	Percent Manning <sup>b</sup>	Manpower Utilization <sup>c</sup>
Quality	09	19*
Maintenance	-07	24**
Readiness	06	11
Pressure	06	09
Efficiency	03	18*
Cooperation	11	13
Leadership	14	00
Injury Rate	-04	-31**

\* $p < .05$ .

\*\* $p < .01$ .

$n = 123$ .

<sup>a</sup>Decimal points have been omitted.

<sup>b</sup>The Percent Manning is the authorized number of division personnel divided by the actual number.

<sup>c</sup>The Manpower Utilization scale is the sum of the responses to four questionnaire items.

perceptions of work activity coordination; (b) division members' feelings that they did a whole piece of work as opposed to doing part of a job which was finished by someone else; (c) division members' feelings that they were helped by their co-workers; and (d) division members' perceptions of their workloads.

In Table 5 it can be seen that the Manpower Utilization scale was a predictor of division performance and injury rate while the objective measure of manning level (the ratio of authorized to actual personnel) was not. Manning level did not correlate with any of the performance criteria or with injury rate while the Manpower Utilization scale correlated significantly with four of the criterion measures. Thus, merely having sufficient manpower was not an important determinant of division performance or accident rate, but how personnel were utilized or coordinated in their work activities was related to division effectiveness and safety.

**Injury Rates by Division.** Differences among divisions in perceptions of work area safety and in injury rates are shown in Figure 4. Boilers and Machinery division personnel perceive their work environments as unsafe and experience relatively high injury rates. This relationship suggests that injuries are primarily the result of hazardous environmental conditions in these divisions. Deck division personnel do not perceive their work environments as

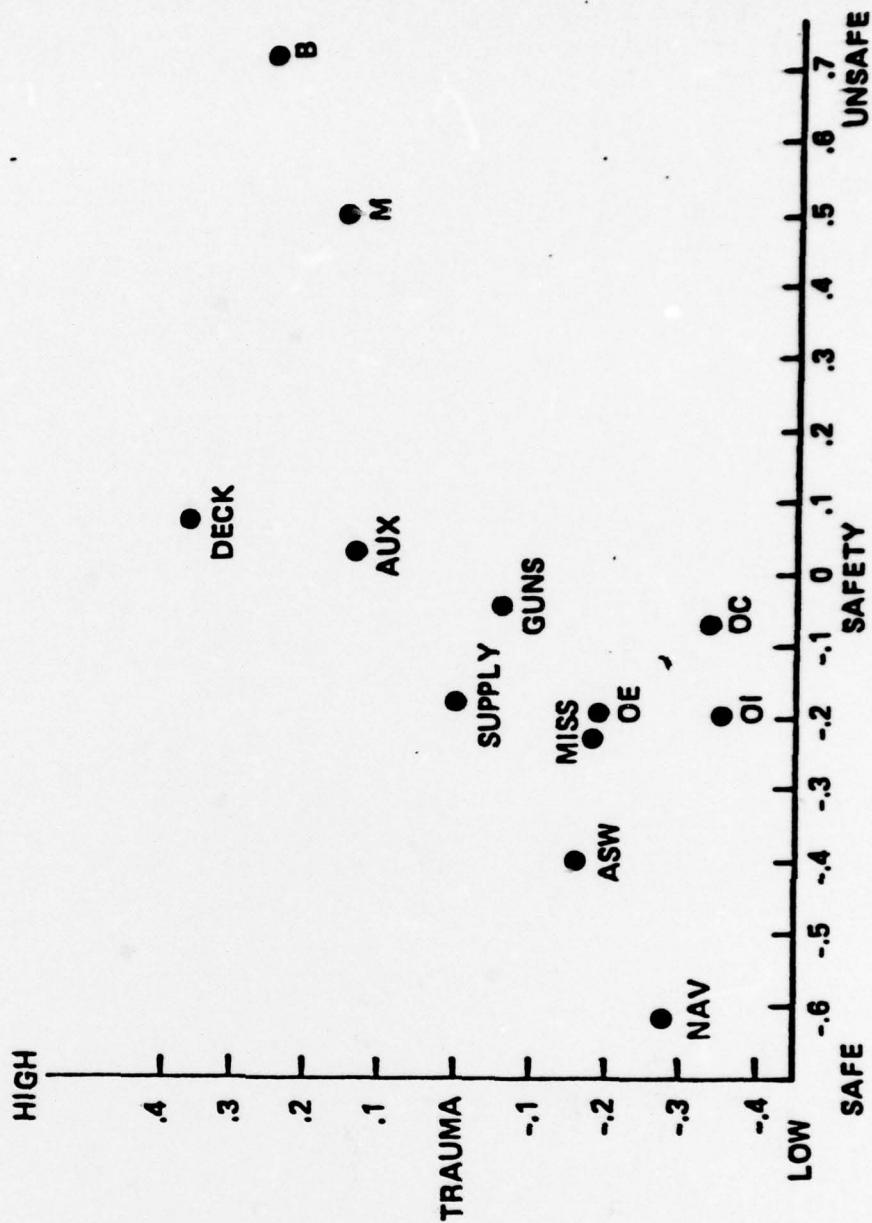


Fig. 4. Safety perceptions and injury rates by division.

particularly unsafe but nevertheless incur the highest injury rate of any division. The climate profile for Deck divisions (see Table 2) indicates a very unfavorable work climate—very low job challenge, very low work group cooperation, and low leader support—which suggests severe difficulties in coordination and control. In any case, the relatively high injury rates for Boilers, Machinery, and Deck divisions affirm the need for more effective control efforts in these divisions to prevent accidents.

### DISCUSSION

The naval organization as a whole has a prescribed formal structure and a universal system of regulations and reward-punishment procedures designed to control the behavior of its members. At the ship subsystem level, organizational units (divisions) vary markedly in personnel resources, physical environments, division structures, and work climates. Coordination and control problems and effective management practices would be expected to vary in accordance with the characteristics of these heterogeneous division types.

Organizational variables that correlated with division performance appeared to have implications with respect to degree and types of coordination and control problems. Smaller division size with less complexity (less specialization and fewer hierarchical levels) would be expected to result in less difficult coordination and control problems (Lawler, 1976); high quality of personnel in terms of intellectual aptitudes, education, advanced training, and job experience should make coordination and control easier; a work group climate of cooperation, friendliness, and warmth should facilitate coordination and control efforts, and divisions with high levels of job challenge and leader support and a low degree of role ambiguity and conflict should be expected to have minimal coordination and control problems.

In the present study, Boilers, Machinery, and Deck divisions not only had hazardous work environments but unfavorable work climates as well. Coordination and control under these conditions would appear to be particularly difficult. It is noteworthy that not only are injury rates highest in these divisions, but on a subsample of seven ships with disciplinary data general illness rates, job dissatisfaction, and disciplinary rates also were found to be exceptionally high for these divisions. A greater degree of management control obviously is needed in hostile or hazardous work environments to protect workers' health and safety, but can stricter regulation with additional deprivations and frustrations be imposed without adversely affecting cooperation and motivation?

The objective of a combat ship is to be in a state of operational readiness at all times to meet any emergency. This need for a rapid and reliable response capability places many constraints on organizational operations, and

coordination and control systems must be designed to fit this primary aim. Accordingly, control systems for the ship as a whole are authoritarian or autocratic in character, particularly under emergency conditions. However, at the division level, where heterogeneity of tasks, personnel, and environments is the rule, different leadership styles and control techniques may prove effective within a general framework of traditional authority. For example, in small divisions with advanced technology and highly trained personnel, division members reported considerable autonomy or self-control in carrying out their jobs. At the same time, these personnel are subject to certain ship-wide controls and to the same Navy-wide controls with respect to standards of conduct, promotion opportunities, etc., as are all other sailors. Thus, it seems useful to view coordination and control within the context of a social systems model in which relationships among context, structure, process, physical environment, and climate components can be analyzed at each level separately and integrated over several organizational levels. Such efforts are in progress at the Naval Health Research Center, San Diego.

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Organizational climate Environmental effects Subsystem performance Accident rate Organizational control		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Problems of coordination and control in naval organizations were explored within the framework of a social systems or integrating model. The relation- ships of organizational variables to subsystem performance and health (safety) were examined in a sample of 4,315 Navy enlisted men aboard 18 destroyer-type ships. Large differences among ships' divisions in work area characteristics, organizational climates, and injury rates indicated that the division is the most important level for subsystem analyses in this type of organization. The		

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differing patterns of organizational variable-division performance relationships for two division clusters defined as high in technical requirements and low in technical requirements and the high injury rates for low technical divisions indicated that different degrees and forms of coordination and control were needed in different types of divisions.

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